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Der Präsident des Europäischen Patentamts;
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For the President of the European Patent Office

Le Président de l'Office européen des brevets
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R C van Dijk



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Anmelder/Applicant(s)/Demandeur(s):

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Bezeichnung der Erfindung/Title of the invention/Titre de l'invention:
(Falls die Bezeichnung der Erfindung nicht angegeben ist, siehe Beschreibung.
If no title is shown please refer to the description.
Si aucun titre n'est indiqué se référer à la description.)

Combined shut-off valve and cover for an engine breather system

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1 "Combined Shut-off Valve and Cover for an Engine
2 Breather System"

3

4 TECHNICAL FIELD

5

6 This invention relates to breather systems in
7 internal combustion engines which allow the free flow
8 of bypass gases and air movement between chambers of
9 the engine during engine running, and to shut-off
10 valves provided in such breather systems to prevent
11 oil in the breather system from entering the engine
12 induction system, and is particularly but not
13 exclusively applicable to closed circuit breather
14 systems.

15

16 BACKGROUND

17

18 An internal combustion engine typically has three
19 chambers, the crankcase, the timing case and the top
20 cover. Each of these chambers must be openly

1 connected to allow free flow of bypass gases and air
2 movement during engine running. In a closed breather
3 system blow-by gas escapes past the piston into the
4 crankcase where it mixes with airborne oil droplets
5 and is fed back into the engine induction system.
6 The blow-by gas passes through a woven mesh oil
7 separator which separates the oil from the blow-by
8 gas before allowing the oil to return to the sump
9 under gravity. The blow-by gas then continues
10 through a pressure regulation valve to the induction
11 manifold. The pressure regulation valve typically
12 has a spring-loaded diaphragm which closes when the
13 induction depression overcomes the spring load.
14 Positive crankcase pressure opens the diaphragm and
15 allows blow-by gases to escape into the air intake
16 system. Negative crankcase pressure closes the
17 diaphragm and prevents blow-by gases being drawn back
18 into the engine.
19
20 In the known closed circuit breather systems there is
21 a reliance on gravity to ensure that oil in the blow-
22 by gases returns to the sump. Under abnormal
23 operating conditions, such as sump overfill or
24 excessive blow-by of oil arising from a worn engine,
25 there is a risk that oil may not return to the sump,
26 but may be directed to the pressure regulation valve
27 and hence to the engine induction system by gravity,
28 resulting in undesirable engine emissions. If the
29 engine is mounted in a vehicle or machine which is
30 operated at an extreme inclination or rolls over,
31 there is a risk that substantial quantities of oil

1 can flow under gravity and enter the engine induction
2 system. This can cause the engine to run in an
3 ungoverned condition and can result in damage to the
4 engine as well as undesirable engine emissions.

5

6 The present invention seeks to provide a shut-off
7 valve for a breather system which overcomes one or
8 more of these problems.

9

10 SUMMARY OF THE INVENTION

11

12 The present invention provides a closed circuit
13 breather apparatus for an engine breather system
14 comprising a cylinder head cover, and a shut off
15 valve provided beneath the cylinder head cover. The
16 shut off valve includes an aperture in communication
17 with a ventilation inlet passage and a valve float
18 restrained to move between a first position in which
19 the aperture is open and a second position in which
20 the aperture is closed.

21

22 The present invention also provides a cylinder head
23 cover including a shut off valve integral with said
24 cylinder head cover and in communication with a
25 ventilation inlet passage integral with said cylinder
26 head cover.

27

28 BRIEF DESCRIPTION OF THE DRAWINGS

29

30 Figure 1 is an end view of an internal combustion
31 engine having a closed circuit breather system

1 according to the prior art, including a pressure
2 regulation valve;

3

4 Figure 2 is a cross-sectional view of the pressure
5 regulation valve of Figure 1;

6

7 Figure 3 is a view from below of part of a cylinder
8 head cover including a closed circuit breather
9 apparatus according to a first embodiment of the
10 present invention;

11

12 Figure 4 is a cross-sectional view on line X-X of the
13 closed circuit breather apparatus of Figure 3 with
14 the shut off valve in an open position;

15

16 Figure 5 is a cross-sectional view on line X-X of the
17 closed circuit breather apparatus of Figure 3 with
18 the shut off valve in a closed position; and

19

20 Figure 6 is a detailed view of the shut off valve of
21 the closed circuit breather apparatus of Figure 3.

22

23 DETAILED DESCRIPTION

24

25 A known closed breather system 10 is shown in Figures
26 1 and 2. An engine 12 has a crankcase 14, an air
27 filter 16 and an induction manifold 18. Blow-by gas
28 which escapes past the pistons (not shown) into the
29 crankcase 14 mixes with airborne oil droplets in the
30 crankcase and is fed back to the engine induction
31 system. The gas first passes through the crankcase

1 breather pipe 20 to a combined filter/separator 22
2 which separates the oil from the blow-by gas before
3 allowing the oil to return to the crankcase 14 under
4 gravity. The blow-by gas then continues through a
5 pressure regulation valve 24 and along an air intake
6 pipe 26 to the induction manifold 18. The closed
7 breather system shown in Figure 1 does not include a
8 shut-off valve.

9
10 The pressure regulation valve 24 is shown in more
11 detail in Figure 2 and has a housing 28 with a
12 crankcase inlet 30 connected to the crankcase
13 breather pipe 20 via the combined filter/separator 22
14 and an induction manifold outlet connected to the air
15 intake pipe 26. Mounted in the housing 28 is a
16 spring-loaded diaphragm 32 which closes when the
17 induction depression overcomes the load in the spring
18 34. Positive crankcase pressure opens the diaphragm
19 32 to the position shown in Figure 2, thereby
20 allowing blow-by gases to escape into the air intake
21 system along the path indicated by the arrows 36
22 Negative crankcase pressure closes the diaphragm 32
23 and prevents blow-by gases being drawn back into the
24 engine.

25
26 One embodiment of a closed circuit breather apparatus
27 50 according to the invention is described with
28 reference to Figures 3 to 6, by way of example only.

29
30 The closed circuit breather apparatus 50 includes a
31 pressure regulation valve 52 similar to the pressure

1 regulation valve 24 shown in Figure 2, but it is to
2 be understood that the pressure regulation valve 52
3 may be omitted or may be provided separately. The
4 closed circuit breather apparatus 50 includes a
5 cylinder head cover 54, which in use covers the
6 cylinder head 56, thereby enclosing the valves (not
7 shown) and valve operating mechanism 57 within the
8 engine valve chamber 58. A gasket 59 seals the
9 cylinder head cover 54 to the walls of the cylinder
10 head 56. The valve operating mechanism 57 may be any
11 suitable mechanism, such as a rocker shaft, an
12 electrically operated mechanism or a hydraulically
13 operated mechanism.

14
15 The pressure regulation valve 52 is mounted within
16 the cylinder head cover 54 and includes a cover plate
17 60 beneath which is a spring-loaded diaphragm 62
18 which closes when the induction depression overcomes
19 the load in the spring 64. Positive crankcase
20 pressure opens the diaphragm 62 to the position shown
21 in Figure 4, thereby allowing blow-by gases to pass
22 into the air intake system along the path indicated
23 by the arrows 66.

24
25 The closed circuit breather apparatus 50 includes a
26 ventilation inlet passage 68 and a ventilation outlet
27 passage 70, which convey blow-by gases through the
28 pressure regulation valve 52. A connecting aperture
29 72 connects a shut off valve 74 to the gas inlet
30 passage 68. The shut off valve 74 includes a valve
31 float 76 movably held in a guide cage 78 comprising

1 an upper cylinder 80 and three lower legs 82 which
2 project downwardly from the cylinder 80. The
3 cylinder 80 has a valve seat 84 at its upper end.
4 The connecting aperture 72 is provided in the valve
5 seat 84. The lower legs 82 are connected at their
6 lower ends to form a seat 86 which limits the
7 downward travel of the valve float 76 in the guide
8 cage 78.

9
10 Screws or other suitable fixings (not shown) pass
11 through apertures 88 in a flange 90 connected to the
12 guide cage 78, in order to secure the shut off valve
13 74 to the cylinder head cover 54. Alternatively the
14 guide cage 78 may be formed integrally with the
15 cylinder head cover 54, or fixed by any other
16 suitable means.

17
18 The form of the guide cage 78 may vary, for example
19 it may have a different number of legs 82, and the
20 legs may extend the full height of the guide cage 78.

21
22 The valve float 76 has a density less than that of
23 oil, so that it is able to float on any oil 92
24 entering the engine valve chamber 58. The valve
25 float 76 may be a ball float, for example a hollow
26 ball of plastic or metal, or any other suitable
27 construction.

28
29 The ventilation outlet passage 70 comprises a
30 tapering outlet passage 94, which is formed
31 integrally with the cylinder head cover 54. A first

1 portion 96 of the outlet passage 94 extends beneath
2 the cylinder head cover 54, best seen in Figure 3 in
3 which the rocker shaft 57 is omitted for clarity. A
4 second portion 98 of the outlet passage 94 extends
5 through the side wall 99 of the cylinder head cover
6 54 to an outlet 100 positioned outside the cylinder
7 head cover 54. In the example of Figs. 4 and 5 a
8 pipe 102 is connected by a seal 104 to the outlet
9 100. The pipe 102 is in communication with the
10 induction chamber (not shown) of the engine. Other
11 forms of connection may be made to the outlet 100.

12 13 INDUSTRIAL APPLICABILITY

14
15 The closed circuit breather apparatus 50 of the
16 present invention provides a compact structure for
17 preventing any oil passing through the breather
18 system in the event of oil entering the engine valve
19 chamber 58, and for reducing the carryover of oil
20 droplets into the breather system.

21
22 In normal engine operation the valve float 76 sits on
23 the seat 86 in the first position shown in Fig. 4,
24 thereby allowing the passage of blow-by gases up
25 through the vent passages (not shown) from the engine
26 crankcase (not shown), through the connecting
27 aperture 72, into the ventilation inlet passage 68
28 and along the path indicated by the arrows 66. The
29 shut off valve 74 prevents large oil drops, which are
30 typically greater than 10 microns in size and are
31 present as a result of rocker lever movement in the

1 engine valve chamber 58, from entering the
2 ventilation inlet passage 68. Blow-by gases follow a
3 tortuous path through the shut off valve 74, since
4 they cannot flow straight up through the shut off
5 valve 74 to the aperture 72. As the blow-by gases
6 change direction, oil droplets are deflected onto the
7 guide cage 78 and valve float 76, thereby reducing
8 oil carryover to the engine induction system.

9
10 If oil enters the engine valve chamber 58, due to
11 abnormal operating conditions such as such as sump
12 overfill, excessive blow-by of oil arising from a
13 worn engine, or operation of the engine on a
14 ~~gradient, the level of oil 92 will rise. As the~~
15 level of oil 92 rises the valve float 76 rises until
16 it is seated against the valve seat 84 in a second
17 position shown in Fig. 5, thereby covering the
18 aperture 72 and preventing the passage of blow-by
19 gases through the connecting aperture 72 into the
20 ventilation inlet passage 68.

21
22 If the engine overturns the valve float 76 will fall
23 under gravity until it is seated against the valve
24 seat 84 in the second position shown in Fig. 5, even
25 before the engine valve chamber 58 fills with oil,
26 thereby covering the aperture 72 and preventing the
27 passage of oil through the connecting aperture 72
28 into the ventilation inlet passage 68.

29
30 The shut off valve 74 thus prevents oil in the closed
31 circuit breather system from entering the engine

1 induction system, which can cause the engine to run
2 in an ungoverned condition and can result in engine
3 damage.

4
5 The closed circuit breather apparatus 50 of the
6 present invention permits the introduction of a shut
7 off valve 74 into an engine breather system without
8 increasing the height of the engine or its
9 components, since the shut off valve 74 is contained
10 within the cylinder head cover 54 and utilises space
11 in the engine valve chamber 58 which would otherwise
12 be unused. The shut off valve is simple to fit, is
13 not positioned outside the engine where it is
14 susceptible to damage, does not require associated
15 external pipework and eliminates potential leak
16 paths.

17
18 It is to be understood that the geometric arrangement
19 of the shut off valve 74 and the inlet and outlet
20 passages 68, 70 may be varied to suit the layout of
21 the engine, as will be apparent to the person skilled
22 in the art. The cylinder head cover 54 may be a
23 complete cover, a top cover or a part cover. The
24 material of the shut off valve 74 and the cylinder
25 head cover 54 can be any suitable material, for
26 example aluminium, alloy, pressed steel, composite
27 material, thermosetting plastic or thermoplastic.
28 The shut off valve 74 may be formed integrally with
29 the cylinder head cover 54, or may be formed
30 separately and then attached to the cylinder head
31 cover 54 to form an integral unit. Other

- 1 modifications may be made within the scope of the
- 2 appended claims.

1 Claims

2

3 1. A closed circuit breather apparatus for an
4 engine breather system comprising:

5 a cylinder head cover, and

6 a shut off valve provided beneath the cylinder
7 head cover,

8 the shut off valve including an aperture in
9 communication with a ventilation inlet passage and a
10 valve float restrained to move between a first
11 position in which the aperture is open and a second
12 position in which the aperture is closed.

13

14 2. A closed circuit breather apparatus according to
15 Claim 1, wherein the shut off valve includes a guide
16 cage which restrains the valve float for movement
17 between the first and second positions.

18

19 3. A closed circuit breather apparatus according to
20 Claim 2, wherein the guide cage is fixed to the
21 underside of the cylinder head cover.

22

23 4. A closed circuit breather apparatus according to
24 any preceding Claim, wherein the valve float is a
25 ball float and covers the aperture when the valve
26 float is in the second position.

27

28 5. A closed circuit breather apparatus according to
29 any preceding Claim, further including a pressure
30 regulation valve in communication with the
31 ventilation inlet passage.

1 6. A closed circuit breather apparatus according to
2 Claim 5, further including an outlet passage in
3 communication with the pressure regulation valve, the
4 outlet passage having a first portion provided
5 beneath the cylinder head cover and a second portion
6 extending through the cylinder head cover to an
7 outlet outside the cylinder head cover.

8
9 7. An internal combustion engine including a closed
10 circuit breather apparatus according to any preceding
11 Claim.

12
13 8. A cylinder head cover including a shut off valve
14 ~~integral with said cylinder head cover and in~~
15 communication with a ventilation inlet passage
16 integral with said cylinder head cover.

17
18 9. A cylinder head cover according to Claim 8
19 further including:

20 a ventilation outlet passage integral with said
21 cylinder head cover; and

22 a pressure regulation valve in communication
23 with the ventilation inlet passage and the
24 ventilation outlet passage.

25
26 10. An internal combustion engine including a
27 cylinder head cover according to Claim 9 or 10.

1 Abstract

2
3 In prior art engine breather systems shut off valves
4 which prevent oil from entering the engine induction
5 system have been mounted externally on the engine and
6 require associated external pipework. Both the shut
7 off valve and pipework are prone to damage and
8 leaking. The closed circuit breather apparatus of
9 the present invention includes a cylinder head cover
10 and a shut off valve provided beneath the cylinder
11 head cover. The shut off valve includes an aperture
12 in communication with a blow-by gas inlet passage and
13 a valve float restrained to move between a first
14 position in which the aperture is open and a second
15 position in which the aperture is closed. Preferably
16 the shut off valve is integral with the cylinder head
17 cover. The shut off valve is thus packaged inside
18 the engine valve chamber, making it easy to fit and
19 eliminating leak paths.

1/3

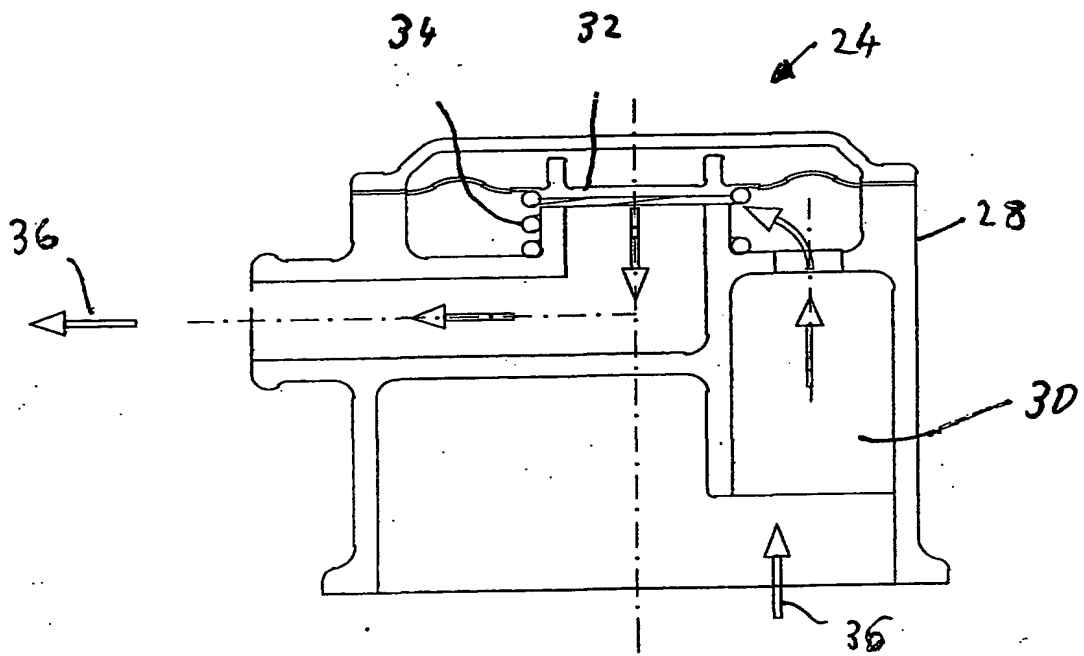
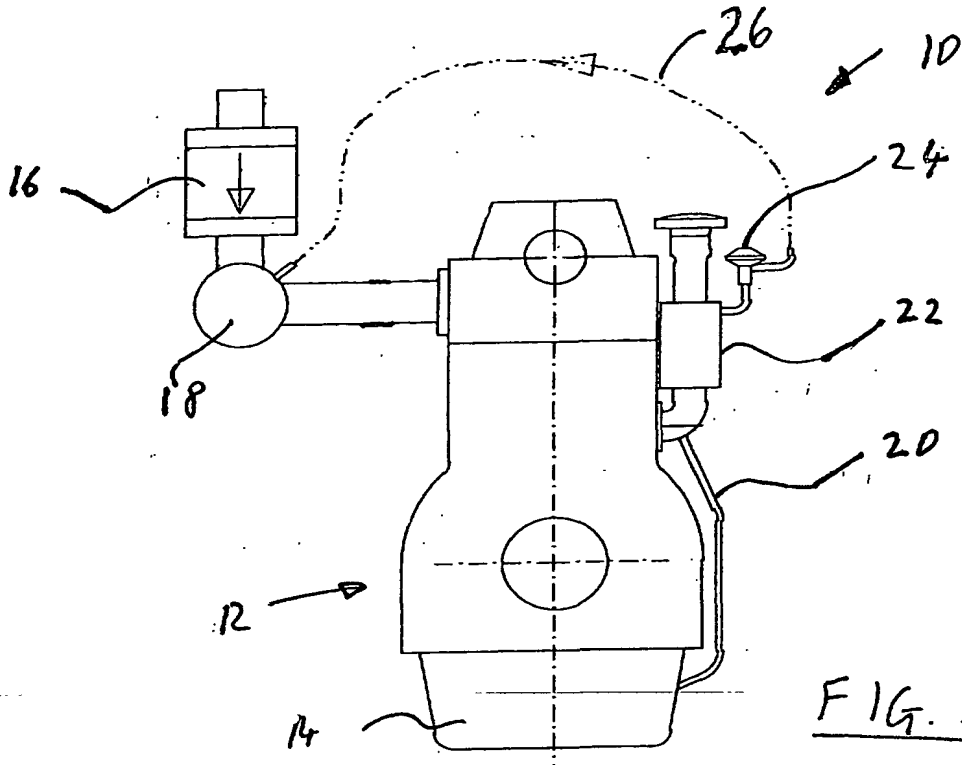


FIG. 3

